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# (54) IMPROVEMENTS IN OR RELATING TO A TUBULAR FILTER MEMBRANE

(71) We, ALFA-LAVAL AKTIEBOLAG, a Swedish corporate body of Postfack, S-147 00 Tumba, Sweden, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to tubular filter membranes which are particularly suitable for reverse osmosis and ultrafiltration.

The liquid to be treated is usually caused to flow through the membrane tubes under a certain pressure, the permeate and filtrate, respectively, penetrating the tube walls and the liquid having been enriched in products, which may be dissolved or finely suspended in the liquid, discharging from the outlet ends of the tubes. Thus, in a reverse osmosis of brine, the brine which is discharged from the tubes has an increased salt percentage, while the permeate becomes free from salt. A similar process occurs for an aqueous solution of proteins, this process being called ultrafiltration, i.e. separation of dissolved substances with molecular weights greater than 500.

The membrane may consist of cellulose acetate, for example, and have a thickness of about 0.2 mm. Such a membrane is, however, not strong enough to withstand, without stretching or bursting, the pressure prevailing in the membrane tube, which can, for example, be greater than 2 kg/cm<sup>2</sup>. This pressure has, in known membranes been withstood by a relatively thick envelope of another tenacious and porous material which is thus permeable to liquid. An example of such an envelope is shown in U.S. Patent Specification No. 3,563,889, according to which the envelope consists of a plaited fabric. A disadvantage of such an envelope is, however, that it has a large number of nooks or crevices which form collection places for bacteria. The existence of these collection places is not compatible with the sanitary requirements which are desired when

treating liquids containing substances which can form nutriment for bacteria.

Furthermore, when the membrane and support tube described in U.S. specification No. 3,563,889 is subjected to an inner pressure the tube will stretch in the axial or radial direction and such movement may cause cracks to form in the membrane thus permitting the seepage of liquid therethrough.

The invention provides a tubular filter membrane having a wall permeable to liquid and a tubular reinforcing means which is completely embedded in the membrane material and consists of threads crossing each other, the threads having a higher tensile strength than the membrane material and constituting the only support for the membrane material, wherein the threads extend inside the membrane material in two substantially mutually perpendicular directions, one of the directions being generally axial.

The reinforcing means may consist of a tubular woven fabric which enables the filter membrane to be manufactured simply and cheaply.

A membrane in accordance with the invention will now be described, by way of example, with reference to the accompanying drawing, which shows an axial section of the membrane wall.

The tubular, semipermeable membrane 1, is formed of cellulose acetate and has a wall thickness of about 0.25 mm. A tubular woven fabric is cast into the tube wall and comprises superpolyamide threads with a thickness of about 0.1 mm. Threads of superpolyamide are known to have a high tensile strength. As shown in the drawing, the threads 2 extend longitudinally of the tube and the threads 3 extend circumferentially around the tube. The threads may form a woven fabric.

The inside and the outside of the membrane are smooth, and without bacteria-collecting nooks or crevices. Since the above-described membrane tubes do not have a greater wall thickness than corresponding membrane tubes which are not reinforced

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it is possible to arrange within the same space a greater number of tubes than in plants with membrane tubes having supporting elements. Thus, an appreciably higher throughput capacity (containing an essentially greater number of membrane tubes or greater membrane area) can be obtained than with previously known plants provided with membrane supports. Furthermore, the manufacture cost for such a plant becomes appreciably lower.

Finally, the above-described membrane avoids the disadvantage occurring in most of the earlier known plants, that, owing to the manufacturing tolerances there is formed a play between the outside of the membrane tube and the inside of the envelope. This play has the effect that during operation when an internal pressure is applied to the tube, it is stretched such that the pores of the membrane are enlarged with the result that the separation characteristics of the membrane are changed and that the membrane tube can burst.

#### WHAT WE CLAIM IS:—

1. A tubular filter membrane having a wall permeable to liquid and a tubular reinforcing means which is completely embedded in the membrane material and consists of threads crossing each other, the threads having a higher tensile strength than the membrane material and constituting the only support for the membrane material, wherein the threads extend inside the membrane material in two substantially mutually perpendicular directions, one of the directions being generally axial.

2. A membrane according to claim 1, wherein the reinforcing means consists of a tubular, woven fabric.

3. A tubular filter membrane substantially as herein described with reference to the accompanying drawing.

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COMPLETE SPECIFICATION

1 SHEET

*This drawing is a reproduction of  
the Original on a reduced scale*

